ELECTRONICS AND ADVANCED TECHNOLOGIES *EAT315124*

External Assessment Specifications

External Assessment Specifications inform the development of external assessments and must be read in conjunction with the *Electronics and Advanced Technologies* course document on the TASC website. The primary audience for this document is the course Marking Coordinators, markers, teachers and students.

The external assessment consists of one component:

- an exam.

FORMAT AND STRUCTURE

The external assessment for this course consists of a **written exam**.

The written exam is **THREE hours**.

The written exam includes **FIVE sections**.

Students will have an additional 15-minute preparation time during which students can take notes on the note paper provided and highlight any key words in the exam booklet during the allocated time. Students will not be permitted to start their exam until advised by the Exam Supervisor.

There will be FIVE booklets.

CRITERIA TO BE ASSESSED

The criteria to be externally assessed are:

- Criterion 3 apply professional electronic engineering practices to safely construct, test and evaluate electronic systems
- Criterion 5 explain and apply mathematical concepts and scientific inquiry in relation to electronics
- Criterion 6 analyse and apply concepts and principles relating to discrete components and analogue circuits
- Criterion 7 analyse and apply concepts and principles relating to integrated circuits
- Criterion 8 analyse and apply concepts and principles relating to programmable circuits.

All elements of all criteria listed above will be assessed.

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SPECIFIC MATERIALS AND EQUIPMENT APPROVED FOR USE BY STUDENTS

- Current TASC EAT315124 Electronics Information Sheet.
- A TASC-approved calculator.

ASSESSMENT

All criteria are assessed numerically with marks indicated for each criterion in each section.

A set of solutions or a marking tool will be developed by the Setting Examiner, provided to markers at the marking meeting that follows the external written exam, and will be available from TASC in the following year.

The external assessment must include questions that, separately or together, give opportunities to demonstrate the standards from rating C to rating A.

Final results will be awarded as a rating of A, B, C, t or z in the above criteria. These ratings are used in determining the final award according to the algorithm in the course document.

NUMERICAL MARK ALLOCATION

Exam papers are designed so that the number of marks allocated to a section, part or question corresponds to the recommended time allocation for it. This is so that a student knows when answering a 10-mark question that the question has been designed for students to spend approximately 10 minutes reading, thinking and then answering the question. Students may find that they spend less or more time on certain questions throughout the exam.

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SECTION A

Structure

- This section will take approximately 36 minutes and be allocated 36 marks.
- This section will include between FIVE and SEVEN questions. All questions are compulsory.
- Questions will be mostly broken into items.

This section addresses course content from module 1.

Assessed Criteria

- Criterion 3: apply professional electronic engineering practices to safely construct, test and evaluate electronic systems.

Nature of Questions

- A balance of routine and non-routine contexts.
- A balance of questions requiring a range of responses from short to extended formats.
- Questions will be mostly broken into items, which will be arranged in order of difficulty.
- For each criterion, a balance of 40% (by mark value) recall style questions and 60% analysis and problem-solving style questions.

Nature of Responses

- Mostly closed-ended responses and some open-ended responses.
- Responses will be assessed numerically.

SECTION B

Structure

- This section will take approximately 36 minutes and be allocated 36 marks.
- This section will include between FIVE and SEVEN questions. All questions are compulsory.
- Questions will be mostly broken into items.

This section will address course content from module 2.

Assessed Criteria

- Criterion 5: explain and apply mathematical concepts and scientific inquiry in relation to electronics.

Nature of Questions

- A balance of routine and non-routine contexts.
- A balance of questions ranging from short to extended formats.
- For each criterion, a balance of 40% (by mark value) recall style questions and 60% analysis and problem-solving style questions.

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Nature of Responses

- Mostly closed-ended responses and some open-ended responses.
- Responses will be assessed numerically.

SECTION C

Structure

- This section will take approximately 36 minutes and be allocated 36 marks.
- This section will include between FIVE and SEVEN questions. All questions are compulsory.
- Questions will be mostly broken into items.

This section addresses course content from module 2.

Assessed Criteria

- Criterion 6: analyse and apply concepts and principles relating to discrete components and analogue circuits.

Nature of Questions

- A balance of routine and non-routine contexts.
- For each criterion, a balance of 40% (by mark value) recall style questions and 60% analysis and problem-solving style questions.

Nature of Responses

- A balance of questions ranging from short to extended formats.
- Mostly closed-ended responses and some open-ended responses.
- Responses will be assessed numerically.

SECTION D

Structure

- This section will take approximately 36 minutes and be allocated 36 marks.
- This section will include between FIVE and SEVEN questions. All questions are compulsory.
- Questions will be mostly broken into items.

This section will address course content from module 3.

Assessed Criteria

- Criterion 7: analyse and apply concepts and principles relating to integrated circuits.

Nature of Questions

- A balance of routine and non-routine contexts.
- For each criterion, a balance of 40% (by mark value) recall style questions and 60% analysis and problem-solving style questions.

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Nature of Responses

- A balance of questions ranging from short to extended formats.
- Mostly closed-ended responses and some open-ended responses.
- Responses will be assessed numerically.

SECTION E

Structure

- This section will take approximately 36 minutes and be allocated 36 marks.
- This section will include between FIVE and SEVEN questions. All questions are compulsory.
- Questions will be mostly broken into items.

This section will address course content from module 3.

Assessed Criteria

- Criterion 8: analyse and apply concepts and principles relating to programmable circuits.

Nature of Questions

- A balance of routine and non-routine contexts.
- For each criterion, a balance of 40% (by mark value) recall style questions and 60% analysis and problem-solving style questions.

Nature of Responses

- A balance of questions ranging from short to extended formats.
- Mostly closed-ended responses and some open-ended responses.
- Responses will be assessed numerically.

MARKING

The marking tool will be developed by the setting examiner, reviewed by the marking coordinator, ratified at the initial marking meeting and adopted by all markers.

The marking tool can only include requirements that are already clearly articulated in the course document; for example, it is not acceptable to prescribe that a student must provide three examples of responses to suffering in order to achieve an “A” rating.

Final results for each criterion will be recorded as A, B, C, t or z. These ratings are used in determining the final award according to the algorithm in the course document.

ADVICE TO SETTERS AND CRITICS

Where content from a module is assessed in two different sections of the exam, care must be taken to ensure that the same content is not assessed twice.

Questions must be structured in a way that information from one section relating to a specific module cannot be used in responses in another section that also addresses the same module content.

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ADVICE TO STUDENTS AND TEACHERS

It is recommended that teachers expose students to a wide variety of written response questions that probe both knowledge and understanding of the principles covered. Questions presented as in-class challenges or assignments that are more open-ended and require students to research or use assistance are appropriate for preparation but should be in addition to exposure to short answer questions similar to test and exam questions.

Question types may be like the following:

- Short answer/calculation type questions (e.g., calculate the resistance vale…)
- Prediction based on changes to a circuit (e.g., Describe the changes you would see if <component> is changed/removed)
- Identify suitable circuits for an application (e.g., Which transistor topology would be appropriate to use in this application)
- Construct/deconstruct a system design (e.g., Draw the function block diagram for <design brief>, OR Draw the function block diagram that represents this <circuit schematic>)
- Microcontroller methodologies, such as IDE, modules & I/O devices, limitations, communications protocols etc. (e.g., Describe the advantage of using libraries when developing software for a project using a microcontroller)
- Identify suitability, and limitations of choices between circuits or technologies. (e.g., why would a regulator be a better choice than simply using a voltage divider to reduce voltage for <application>).

Memorising circuit schematics will not be needed; however, students will need to know the function of many circuits that will be included in the information sheet. Students who deeply understand the function of discrete components (i.e., can “simulate on the page”) will find this task easier.

When required, writing of code will be system and language agnostic. i.e., students are not required to learn a specific language or system. Questions will be scaffolded so that students need to demonstrate understanding of the principles, rather than the specifics of the language or system.

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APPENDIX A – Types of questions

Routine context:

These questions are set in familiar contexts and generally require rehearsed skills.

(Reference: *Electronics* Exam Paper 2013, Section C, Question 13)

You **must** show your working.

a) Convert the binary number 10100_2 to:

i. Hexadecimal (1 mark)

ii. decimal (1 mark)

b) Express 785_{10} in BCD form. (1 mark)

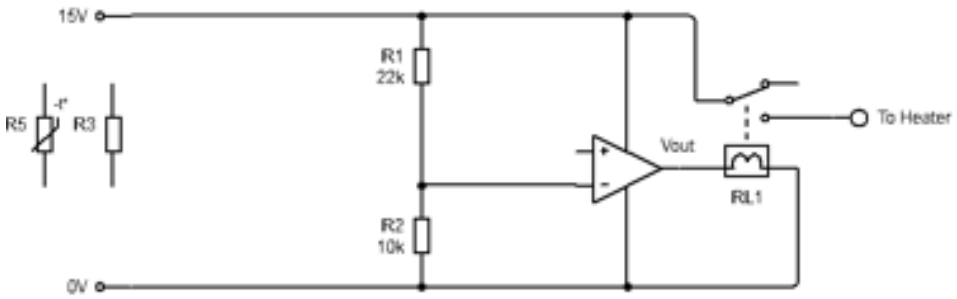
Non-routine context:

These questions are set in unfamiliar contexts and generally require the combination, and sometimes the selection, of a set of skills.

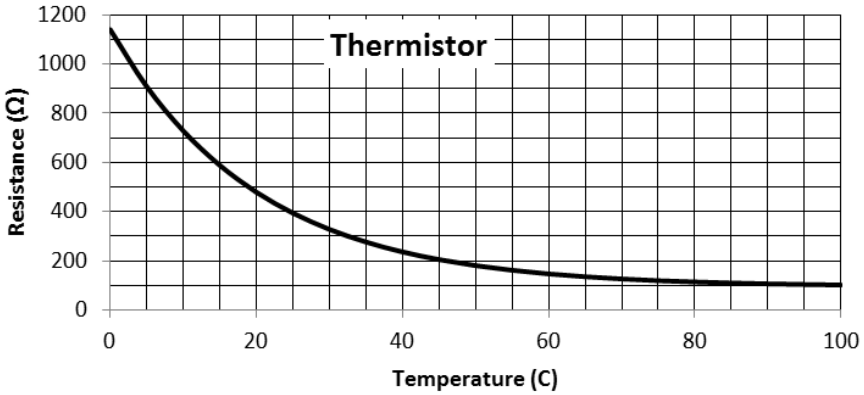
(Reference: *Electronics* Exam Paper 2013, Section B, Question 9)

An experimenter is designing a temperature control circuit for an industrial heater.

This comparator below is part of a test circuit. Components R3 and R5 have not yet been placed in the circuit.



The characteristics of the thermistor are shown below.



The heater will switch on whenever the temperature falls below 45°C.

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a) What is the resistance of the thermistor when the temperature is 45°C? (1 mark)

b) What should the output voltage (V_{out}) be when the temperature is 40°C? Explain why. (1 mark)

c) Place the components R3 and R5 in their appropriate positions in the circuit. (1 mark)

d) Sketch a graph showing the output voltage against the temperature. Indicate a scale on the axes. (Axes are not shown here.) (1 mark)

e) In operation, it was noticed that the heater switched on and off more frequently than desired.

i. By referring to the circuit and graphs, explain why this happens. (1 mark)

ii. One possible solution is to introduce hysteresis into the circuit.

On the axes below, sketch another labelled graph showing clearly the effects of hysteresis on the output voltage. Be sure to indicate the direction of any voltage changes. (Axes are not shown here.) (2 marks)

Short response format:

These questions are composed of a brief prompt that demands a response to some stimulus material that varies from a single response to a few written points.

This sort of question is suited to assessing the student's ability to, but not limited to:

- recall specific information and methods related to key content
- apply rehearsed methods to familiar situations
- demonstrate understanding of key concepts in previously unseen stimulus material.

(Reference: *Electronics* Exam Paper 2013, Section A, Question 1)

Value	Band 1	Band 2	Band 3	Tolerance
12R ± 10%				
	Grey	Red	Yellow	Red
3M9 ± 5%				

a) Complete the table of resistor values. (2 marks)

SECTION	CRITERION	MARKS
471		
		1µ5
	33	

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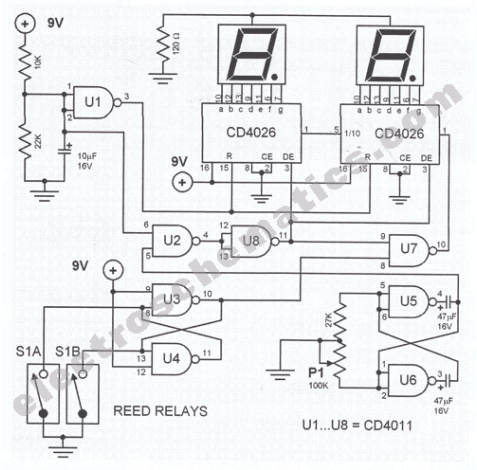
b) Complete the table of capacitor values. (2 marks)

The circuit diagram for a bicycle 'speedometer' is shown.



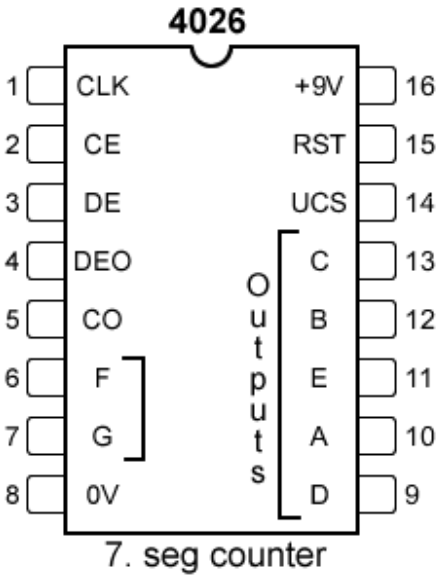
(Source: http://electroschematics.com/451/digital-bike-tachometer)

This *digital DIY speedometer for bikes* uses two reed switches to get the speed information of the bicycle. The reed switches are installed near the rim of the wheel where permanent magnets pass by. The permanent magnets are attached to the wheel spokes and activate the reed switches every time they pass by it. The speed is digitally displayed.

The **speedometer circuit** works according to this principle; the pulses created by the reed contacts are counted within a certain time interval. The resulting count is then displayed and represents the speed of the bike. Two 4026 ICs are used to count the pulses, decode the counter and control two 7-segment LED display. RS flip-flops U3 and U4 function as anti-bounce.

The pulses arrive at the counter's input through gate U7. The measuring period is determined by multivibrator U5/U6 and can be adjusted through potentiometer P1 so that the speedo can be calibrated. The circuit U1/U2 resets the counters.

PIN	FUNCTION
1	Clock In
2	Count Enable
3	Display Enable
4	Display Enable Out
5	Carry Out
14	Ungated C segment
15	Reset



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a) This circuit utilises four ICs: 2 x 4026 and two of another type. Describe the second type. (1 mark)

b) Are the 7-segment displays common-anode or common-cathode? Explain. (2 marks)

c) The two reed-switches (S1A & S1B) feed into U3 and U4. Name the mode of operation of the U3/U4 combination. (2 marks)

d) What is the mode of operation of U5 and U6 and their associated components? (2 marks)

e)

i. When the circuit is operating normally, what is the logic state of Pin 3 of U1? (1 mark)

ii. The output of U1 connects to Pin 15 of the 4026 ICs. What is the function of U1 and its associated components? (3 marks)

f) What is the role of Pin 1 of the 4026 IC? (1 mark)

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